PATENT SPECIFICATION

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(54) APPARATUS FOR UNDERWATER PIPELINE

(71) We, THE BRITISH PETROLEUM COMPANY LIMITED, of Britannic House, Moor Lane, London, EC2Y 9BU, a British Company, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to an apparatus for stabilising a pipeline at an underwater location and also to a method of making the apparatus. The invention also relates to a method of employing the apparatus to stabilise a pipeline at an underwater location.

Pipelines which are laid underwater usually have a weight coating to give the pipeline an adequate negative buoyancy. Usually the weight coating is made of concrete and is several inches in thickness. Sometimes however, the weight coating can be damaged e.g. during laying of the pipeline or by trawling, and sections may be broken off leaving the pipeline exposed. When this occurs the pipeline may not have an adequate negative buoyancy at the damaged parts and may become vulnerable to the effects of tide or currents.

It has been previously proposed to stabilise a pipeline by installing heavy saddle-shaped concrete blocks over the pipeline. Installation of the blocks involves some risk of further damage to the pipeline, since the installation involves lowering the blocks from a boat which is subject to the movement of the waves.

More recently U.K. Patent No. 1,276,468 proposed a method of stabilising an underwater pipeline by positioning on the pipeline a weight, which weight comprises a flexible outer skin containing an aggregate e.g. magnetite and a settable material e.g. bitumen, prior to the settable material being in a set condition, and allowing the settable material to set and form a rigid mass laying across the pipeline.

A pipeline stabilising weight has now been invented having an improved construction.

According to one aspect of the present invention a pipeline stabilising weight comprises a flexible skin enclosing a mixture of a settable material and aggregate, the proportions being such that when the settable material is in a set condition the mixture is bound together in a mass, the mixture being divided into layers by one or more partitions of an inert flexible material extending therethrough to permit relative movement of adjacent layers of the mixture.

Preferably the settable material is bitumen. The term 'bitumen' is intended to include materials known as asphalts.

By the term aggregate we means a mineral material at least 80% of which is of particle size greater than 200 BSS, and whose maximum particle size is not greater than one inch. Preferably the maximum particle size is less than $\frac{1}{2}$ inch. The aggregate can be continuously graded or gap graded.

Preferably the partitions of flexible material are sheets of bitumen roofing felt.

Preferably a number of partitions of flexible material are substantially parallel. More preferably the layers are of substantially equal thickness, for example from 2 to 10 inches, preferably from 4 to 6 inches in thickness.

More preferably each partition of flexible material is made up of two sheets of flexible material separated by a very thin layer of settable material e.g. less than $\frac{1}{2}$ inch, more preferably less than $\frac{1}{4}$ inch e.g. a layer that can be applied in the case of bitumen by painting.

By the term "settable" in the present specification is meant a material which can be liquefied by the application of heat and which on cooling forms a solid or semi-solid mass.

The flexible skin can conveniently be

made of canvas.

When the settable material is bitumen the mixture preferably contains 4 to 12% of bitumen, 70 to 90% of the aggregate, 5 to 15% of a filler all % being by wt of the total mixture.

Preferably the settable material is one which at the temperature of the water in which the stabilising weight is user is capable of bending to an extent that when the weight is placed on a pipeline the weight will bend over the pipeline and make contact with the water bottom on both sides of the pipeline.

When the settable material is bitumen, a filler can be included in the mixture which in an amount sufficient to stiffen the bitumen. By filler we mean a material in the form of particles of not less than 85% of which will pass 200 mesh BSS. Preferably the amount of filler is from 5 to 20% by weight based on the total weight of the mixture. Fillers are well known in the bitumen art and include substances such as limestone.

When the settable material is bitumen a plasticiser can be included in the mixture in an amount to reduce the tendency of the bitumen-containing mass to crack, particularly temperatures from 0 to 20°C. Bitumen plasticisers are well known to those skilled in the bitumen art and include synthetic and natural elastomers such as styrene-butadiene rubbers, polychloroprenes and the like and also natural rubbers. Amounts of plasticiser included in the mixture can be from 1 to 15% wt of the bitumen preferably from 3 to 8% by wt.

Preferably the mixture also comprises an effective amount of an anti-stripping agent e.g. from 0.1 to 8%, preferably 1 to 5% to prevent stripping of the settable material. The anti-stripping agent can be hydrated lime, or an adhesive agent such as a long chain fatty acid amine. The stripping of bitumen by water is a known phenomenon and the term anti-stripping agent is well known in the art.

Preferably the total weight of the stabilising weight in air is from 2 to 20 tons, more preferably from 5 to 7 tons.

According to another aspect of the invention a method for making a pipeline stabilising weight as hereinbefore defined comprises the following steps:

(i) placing the flexible skin in a mould

(ii) adding to a mould an amount of the mixture of settable material and aggregate to form a layer at the base of the mould,

(iii) adding to the layer of mixture at the base of the mould a partition of inert flexible material and optionally repeating steps (i) and (ii) until the required thickness is built up, and

(iv) covering the uppermost layer with the flexible skin and

(v) removing the weight from the mould.

A layer of reinforcing material can be added to reinforce each layer of settable material and aggregate.

Preferably the layers of settable material and aggregate are in the range 2 to 10 inches, more preferably 4 to 6 inches in thickness.

Preferably, after the addition of the first sheet of inert flexible material a very thin layer of settable material e.g. $\frac{1}{4}$ inch is applied to the upper face of the first sheet and a second sheet of inert flexible material then added.

Fig. 1 is a vertical section of a pipeline stabilising weight according to the invention and Fig. 2 is a vertical section of a pipeline stabilising weight in the course of manufacture before removal from its mould.

The invention is illustrated by the following example:

Example

Stabilising Weight

The stabilising weight indicated generally by reference numberal 1 has a flexible skin 2 made of canvas containing a mixture consisting of:

8% bitumen of penetration 100-300 (tenths of mm at 25°C, 100 gm loading 5 seconds loading)
2% hydrated lime (antistripping agent)
80% haematite of particle size greater than 200 mesh BSS but less than inch
10% limestone filler (not less than 85% of the filler passing 200 mesh BSS)

All percentages being by wt of the total mixture.

With reference to Fig. 1 the weight is divided internally into layers each 5 inches in thickness by sheets of bitumen roofing felt 8 and 9 lying parallel to each other. Sheets of felt 8 and 9 are separated by a very thin layer of bitumen applied by painting. Situated at the centre of each layer is a polypropylene reinforcing mesh 7. Lining the base of the canvas skin 2 is a sheet of fibre glass 10 to provide heat insulation.

Method of Manufacture

A mixture for stabilising weight was prepared consisting of:

8% bitumen)
) As defined
2% hydrated lime) As defined
)
80% haematite)
10% limestone filler (all of the filler passing 200 mesh BSS)

All percentages being by wt of the total mixture.

With reference to Fig. 2 a flexible skin made of canvas 2 was placed in an angle iron mould 4 of dimensions 10 feet × 5 feet × 15 inches (high).

On top of the canvas was placed a sheet of fibre glass 10 to provide heat insulation.

The mixture heated to a pourable state (120-150°C) was then added to the mould 4 in an amount to provide a layer about 2½ inches thick. Then a sheet of polypropylene reinforcing wire mesh 7 was added and a further amount of mixture added to provide in total a layer 5 inches in thickness. Then a sheet of bitumen roofing felt 9 was added.

The upper fact of the roofing felt 9 was then painted with bitumen and a second sheet of roofing felt 8 added. Then another 2½ inches of mixture was added and the process was repeated further to provide three layers each 5 inches in thickness. The canvas was then closed at the top of the mould and, employing the lifting strops 6 the weight was removed from the mould 4.

The weight is then ready for use and can be installed on an underwater pipeline immediately or alternatively, can be stored before use.

WHAT WE CLAIM IS:—

1. A stabilising weight for an underwater pipeline comprising: a flexible skin enclosing a mixture of a settable material and aggregate, the proportions being such that when the settable material is in a set condition the mixture is bound together in a mass, the mixture being divided into layers by one or more partitions composed of an inert flexible material extending therethrough to permit relative movement of adjacent layers of the mixture.

2. A stabilising weight as claimed in claim 1 where in the settable material is bitumen.

3. A stabilising weight as claimed in claim 1 or claim 2 wherein the aggregate is an iron-containing ore.

4. A stabilising weight as claimed in any one of Claims 1 to 3 wherein each partition is made up of two sheets of inert flexible material separated by less than ½ inch of settable material.

5. A stabilising weight as claimed in any one of Claims 1 to 4 wherein the partitions of inert flexible materials are substantially parallel.

6. A stabilising weight as claimed in any one of Claims 1 to 5 wherein the layers are of substantially equal thickness.

7. A stabilising weight as claimed in any one of Claims 1 to 6 wherein when the settable material is bitumen the mixture contains from 5 to 20% based on the wt of the mixture of a filler in the form of particles which will pass a 200 mesh B.S.S.

8. A stabilising weight as claimed in Claim 7 wherein the mixture contains: 4 to 12% of bitumen, 70 to 90% of the aggregate and 5 to 15% of filler all % being by wt of the total mixture.

9. A stabilising weight as claimed in any one of Claims 1 to 8 wherein the mixture contains from 0.1 to 8% by wt of an anti-stripping agent based on the wt of the mixture.

10. A stabilising weight as claimed in Claim 2 wherein the mixture contains a plasticiser for the bitumen in an amount sufficient to reduce the tendency of the mass to crack.

11. A stabilising weight as claimed in any one of Claims 1 to 10 wherein each layer contains a sheet of reinforcing mesh therein.

12. A method of making a pipeline stabilising weight as claimed in Claim 1 comprising the following steps:

(i) placing the flexible skin in a mould

(ii) adding to the mould an amount of the mixture of settable material and aggregate to form a layer at the base of the mould

(iii) adding to the layer a partition of the inert flexible material and repeating steps (ii) and (iii) until the required thickness is built up

(iv) covering the uppermost layer with the flexible skin, and

(v) removing the weight from the mould.

13. A method of making a pipeline stabilising weight as claimed in Claim 12 which method comprises incorporating a sheet of reinforcing mesh in each layer of the weight.

14. A method of stabilising an underwater pipeline which method comprises placing over the pipeline at intervals along the length thereof pipeline stabilising weights as claimed in any one of Claims 1 to 11.

15. A pipeline stabilising weight substantially as hereinbefore described with reference to the Example.

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1 SHEET

PROVISIONAL SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.

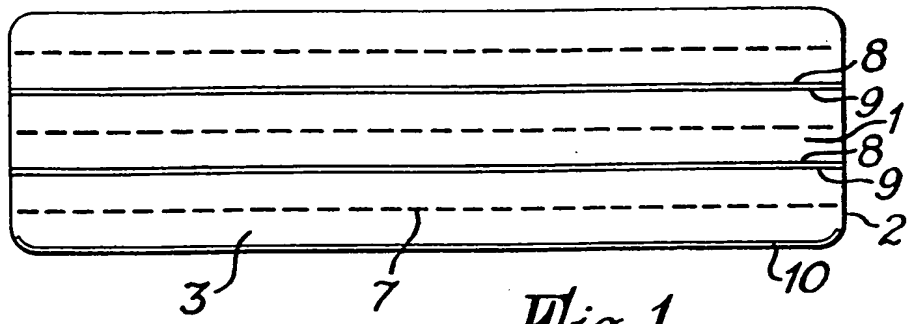

Fig. 1

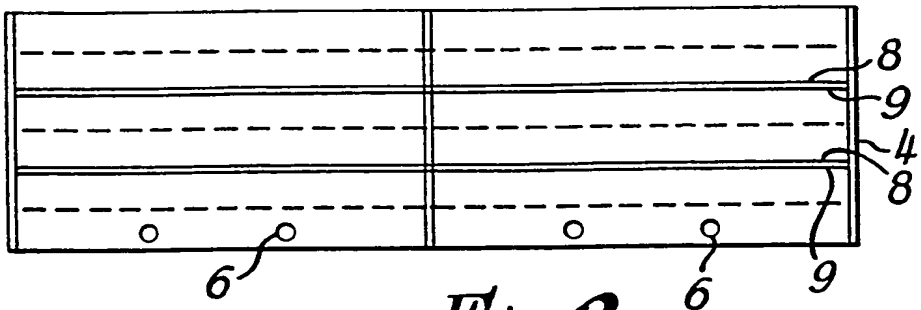

Fig. 2